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(54) CLOSEABLE CONTAINERS HAVING MEANS FOR
 SUPPRESSING FIRE AND/OR EXPLOSION

(71) I, THE SECRETARY OF STATE FOR DEFENCE, LONDON, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to closeable containers having means for suppressing fire and/or explosion and in which there may be present in the ullage a flammable mixture which constitutes a potential fire and/or explosion hazard.

The invention is an improvement in the invention of patent specification 1341693 which discloses the use of pieces of openly reticulated foam within a closeable container which together with the void spaces therein fill the container to an extent that there is left externally of the pieces and within the container a volume equivalent to from 10-50% of the interior volume of the container, the pieces being unattached one to another or to the container.

The present invention is concerned with the more effective use of pieces of openly reticulated foam as a fire and/or explosion suppressing means in containers.

A closeable container according to the present invention has a plurality of openly reticulated foam pieces within it having a porosity of 15-25 pores per linear inch which pieces together with the void spaces within them occupy the container to an extent that there is left externally of and between the pieces and within the container a volume equivalent to more than 50% of the interior volume of the container whereby in the event of a fire within the container an unacceptable pressure rise is prevented.

The foam pieces may comprise balls of foam and may be hollow comprising a foam layer surrounding a hollow interior. Preferably, hollow balls of diameter 1"-6" and wall thickness $\frac{1}{2}$ "-1" may be employed, the

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preferred wall thickness depending on the hardness of the foam as much as the size of the ball.

Using similar polyurethane foam material as disclosed in specification 1341693, i.e. having a density of 12-30 Kg/m³ and being over about 95% void by volume, but with a porosity of 15-25 pores per linear inch it is found that the volume of foam pieces may be considerably reduced for certain conditions as compared with the earlier application.

Experiments show that the ignition of an explosive propane gas/air mixture or a mixture of air and evaporants from aviation fuel in a hollow container may result in a pressure rise of 100 lb/sq in.

In the case of aircraft fuel tanks their ability to withstand internal pressure rises may vary from as low as 2 lb/sq in for civil aircraft to as high as 60 lb/sq in for current military aircraft.

The use of polyurethane foam balls in either solid or hollow form and having a porosity of 15-25 pores per inch which occupy a container to an extent that there is left externally of and between the balls and the interior of the container a volume equivalent to 50% of the tank volume, leads to a consistent and repeatable pressure rise of not more than 25 lb/sq in following ignition of an explosive mixture in the tank.

Similarly if the foam volume used is reduced so that the volume left is 60% and 70% then the pressure rise following ignition is reduced to 40 and 60 lb/sq in, respectively. Thus the maximum volume left in current conditions may be about 70%.

It is found that if the foam used has a porosity of less than 15 pores per linear inch its effectiveness is reduced as it does not provide the desirable refuge volume within it for the advancing pressurised gases which result following ignition of the mix-

ture. Also, if a higher porosity than 25 pores per linear inch is used the drainage rate of fuel from the foam may be too slow.

- 5 To be effective the foam pieces must be in the ullage and for a container which remains stationary the foam pieces are arranged to occupy at least the upper region of the container. Thus as the contents are drained off any ullage formed will contain foam pieces. For containers liable to movement and possible inversion, as in the case of an aircraft fuel tank, the foam pieces will be supported within the containers so that whatever its position some at least of the foam pieces will be present in the ullage as it is formed. For example, foam pieces may be supported adjacent the inner side walls of a container in a netting support.

20 The actual diameter of the pores in the foam will vary both as between pores in a given type of foam and between different types of foam. However, ideally the type of foam used is such that the skeletal strands of material which surround and define the pores are as small as possible. Thus, in the case of a typical polyurethane foam having 15 pores per linear inch, diameter of the individual pores was in general in the range of 0.06-0.064 inches with some smaller and some larger pores as is common with this type of foam material. The preferred density of the foam is 12-15 Kg/m³.

35 Just as described in the above mentioned specification, the container be also be provided with a layer of openly reticulated foam, of similar plastics material but with a porosity of 70-100 pores per inch, covering at least part of its external surface.

40 An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing which is a part sectioned diagrammatic representation of a fuel tank in accordance with the invention.

As shown in the drawing the tank 1 has an inlet and closure assembly 2 and an outlet 3. A net 4 attached to the sides of the tank carries a plurality of hollow polyurethane foam balls 5. The tank is enclosed in a 2" layer of reticulated polyurethane foam 6 having a porosity of 80 pores per linear inch.

WHAT I CLAIM IS:—

1. A closeable container having therein a plurality of openly reticulated foam pieces having a porosity of 15-25 pores per linear inch, which pieces together with the void spaces within them occupy the container to an extent that there is left externally of

and between the pieces and within the container a volume equivalent to more than 50% of the interior volume of the container whereby in the event of a fire within the container an unacceptable pressure rise therein is prevented.

2. A container as claimed in claim 1 and wherein the said external volume is equivalent to more than 50% and up to about 70% of the interior volume of the container.

3. A container as claimed in either claim 1 or claim 2 and wherein the foam pieces include balls of foam.

4. A container as claimed in any one of claims 1 to 3 and wherein at least some of the foam pieces are hollow and comprise a foam layer surrounding a hollow interior.

5. A container as claimed in claim 4 and wherein the hollow foam pieces are substantially spherical, with a diameter of 1"-6" and a wall thickness of $\frac{1}{2}$ "-1".

6. A container as claimed in any one of claims 1 to 5 and wherein the foam has a density of 12-30 Kg/m³ and is at least 95% voids by volume.

7. A container as claimed in claim 6 and wherein the foam has a density of 12-15 Kg/m³.

8. A container as claimed in any one of the preceding claims and having net means for retaining some at least of the said foam pieces in a normally upper part of the container.

9. A container as claimed in any one of the preceding claims and having a layer of openly reticulated foam covering at least part of its exterior surface.

10. A container as claimed in claim 9 and having a foam layer with a porosity of 70-100 pores per linear inch.

11. A container as claimed, in any one of the preceding claims and wherein the foam is made of a plastics material.

12. A container as claimed in claim 11 and wherein the plastics material is a polyurethane ester.

13. A container having foam pieces within it substantially as hereinbefore described and illustrated in the accompanying drawing.

14. A container as claimed in claim 13 and having a layer of openly reticulated material covering at least part of its outer surface substantially as hereinbefore described and illustrated in the accompanying drawing.

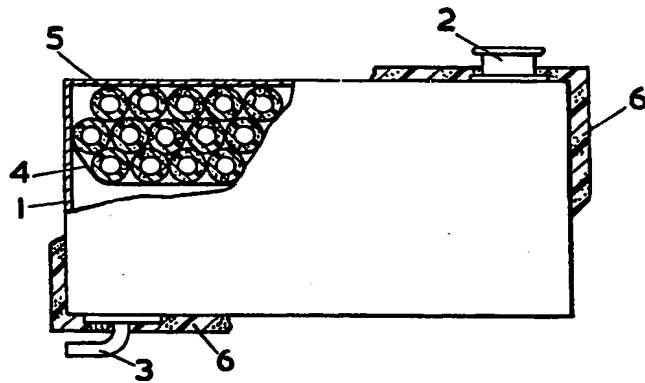
R. A. MILLER,
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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of
the Original on a reduced scale*



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